Adaptive Thinking Training For Tactical Leaders

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Summary

This paper reports a series of research efforts embodied in the U.S. Army's Think Like a Commander training program. The work is interesting because it seeks to train a cognitive behavior – thinking – using methods that have traditionally been applied to training more observable and measurable behaviors, e.g., marksmanship and gunnery, sports performance. In short, it does not greatly respect a traditional distinction between such things as physical movements, perceptions, and cognitions when it comes to training, rather treats these all as behaviors that are amenable to the same training methods and principles. Deliberate practice techniques were applied to develop exercises to train the task of adaptive thinking in tactical situations. The exercises were used in command preparation courses for U.S. Army officers at the brigade, battalion, and company levels. The approach shows promise and initial data indicate significant performance gains in a key component of battlefield adaptive thinking: the rapid analysis of battlefield situations to identify of key considerations for decision-making.

Soviet Chess Training Methods

The notion that thinking can be trained as a behavior has a precedent in practice. For decades, the Soviet chess machine thoroughly dominated all competition. Chessplayers around the world assumed the Soviets achieved their success solely by extra effort in selecting, developing, and supporting promising players. But did the Soviets have some new and secret training methods that the rest of the world did not? Few imagined that. With the breakup of the USSR, Soviet chess academies became publishing houses. The release of such books as Mark Dvoretsky's *Secrets of Chess Training* and *Positional Play* surprised the chess world. It seemed that the Soviets did have methods they hadn't revealed. Subsequently, English-speaking chess trainers have written manuals that applied the Soviet methods to selected aspects of the game, for example Andrew Soltis' book on how to calculate in chess, titled *The Inner Game of Chess*, presents training exercises to develop skill at visualizing future positions by moving pieces in one's imagination.

Researchers at the U.S Army Research Institute (ARI) saw a parallel between the problem of training battlefield commanders to think adaptively in tactical situations and that of training chess grandmasters. They analyzed the Soviet training manuals to understand their methods. The difference between the Soviet methods and traditional chess instruction is, in a sense, the difference between education and training. The rest of the world studied the game of chess, its strategies and tactics, and tried to understand why one move was better than another. As students studied the game, they acquired knowledge about chess and understanding of its principles. They educated themselves about the game of chess. The Soviets did that as well, but also studied the human processes of finding good moves and avoiding errors, of searching and evaluating chess positions, and of controlling emotion and fighting a psychological battle with one's opponent. The Soviets described principles of expert play that reflected the thought patterns of grandmasters. While many of these expert principles were familiar to the rest of the world, the Soviet

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trainers went one critical step further. They created exercises that trained these principles, ingraining them in their students. After sufficient training, the Soviet students employed the expert thought patterns not simply because they understood the principles nor because they were consciously directing their thinking by using the expert patterns as a checklist. The cognitive behaviors had become automatic. As a result of the exercises, the students followed the principles without thinking about them, freeing their limited conscious resources to focus on the novel aspects of the contest and to think more deeply and creatively at the board. The Soviet chess trainers in essence treated the thinking that the player does during a game as a behavior – something a player does with chess knowledge as opposed to the knowledge itself – and then developed exercises to train that thinking performance to conform to that of an expert.

Adaptive Thinking on the Battlefield

The cognitive task to which our research effort has been applied is what has come to be called adaptive thinking by the U.S. Army. The term adaptive thinking, as we define it, "describe[s] the cognitive behavior of an officer who is confronted by unanticipated circumstances during the execution of a planned military operation" (Lussier, Ross, & Mayes, 2000, p.1). The skillful commander will, when performing adaptively, make adjustments within the context of the plan to either exploit the advantage or minimize the harm of the unanticipated event, in short, will adapt to conditions for a more successful outcome. This description of the adaptive thinking task defines the behavior in terms of the problem to be solved – to monitor the unfolding tactical situation for unanticipated events and to determine the proper actions in response to them. Another important aspect of the task involves the conditions under which it must be performed. The thinking that underlies battlefield decisions does not occur in isolation or in a calm reflective environment, it occurs in a very challenging environment. Commanders must think while performing: assessing the situation, scanning for new information, dealing with individuals under stress, monitoring progress of multiple activities of a complex plan. Multitudes of events compete for their attention. Commanders who do not allocate many cognitive resources to adaptive thinking will still likely feel themselves very busy; commanders who do allocate resources to adaptive thinking will need to find ways to free those resources.

Knowledge of the domain area is clearly an important requisite for performing the task well, but it is not sufficient. Typically U.S Army officers after years of study, both in the classroom and on their own, develop a good conceptual understanding of the elements of tactical decision-making. However, that knowledge alone, no matter how extensive, does not guarantee good adaptive thinking. Thinking is an active process; it is a behavior one does with his or her knowledge. As an example, if officers are told that the enemy has performed various actions on the battlefield and they are asked to infer the enemy's intent, they can generally do this fairly well depending on their understanding of the tactical domain. They have both the knowledge and the reasoning ability to solve the problem. Despite that, the same officers when placed in a demanding environment and required to perform as commanders will not necessarily display the behavior, i.e., develop a model of a thinking enemy and update that model based on continuing assessment of enemy actions. Expert adaptive thinking under stressful performance conditions requires considerable training and extensive practice in realistic tactical situations until thinking processes becomes largely automatic.

Habits and Automaticity

Habits develop only through performance. The more you repeat a behavior the more habitual it becomes, whether you want it to or not. This is true of sensorimotor behaviors such as driving a car as well as cognitive behaviors. When one is first learning how to read, for example, one's attention is focused on the shape of the letters and sounding out the words. When the sounding of the words has become automatic, one must focus attention to understand the meaning of the passage. With practice that too – extracting meaning – will become automatic. Then, one can read, understand the story, and think about what the writer is saying and whether one agrees with it. Most U.S. Army officers do not rise to a level of automaticity in battlefield thinking that permits high-quality adaptive thinking. It takes all their conscious attention to operate on the

battlefield and to grasp the nature of what is happening; there are few resources left to think adaptively about the events.

Strong habits are such a critical component of expertise, in fact, that after one has attained some expertise, consciously thinking about habitual elements will usually degrade skilled performance. You cannot consciously control either thought or action with the same level of skill and complexity that you can learn to do them through repetition. Furthermore, stress narrows focus. Habits predominate in times of stress, fatigue, and competing demands for attention. Under such conditions people do what they have done most often; they do what comes automatically.

Training Methods

The cornerstone of developing expertise is the use of deliberate practice. A main tenet of the deliberate practice framework is that expert performance reflects extended periods of intense training and preparation (Ericsson, Krampe, & Tesch-Roemer, 1993). Describing the structure of deliberate practice activities, Ericsson et al. write "…subjects ideally should be given explicit instructions about the best method and be supervised by a teacher to allow individualized diagnosis of errors, informative feedback, and remedial training…. Deliberate practice is a highly structured aim; the specific goal of which is to improve performance. Specific tasks are invented to overcome weaknesses, and performance is carefully monitored to provide cues for ways to improve it further." (p. 367-8)

Traditionally the training of tactical thinking in the U.S. Army has not employed deliberate practice concepts. Instead, officers have been placed in realistic situations, supported by some form of live, constructive, or virtual simulation, and asked to perform in a whole-task environment to the best of their ability. The maxim "train as you fight" has risen to such a level of familiarity in the U.S. Army that the value of the notion goes almost unquestioned. Yet studies of the development of expertise clearly indicate that "as you fight" meaning performing in fully realistic simulated battles is neither the most effective nor efficient method of developing expertise. Such "performances" can help a novice become acquainted with applying military knowledge and can reinforce existing knowledge in an experienced person, but will not in and of themselves lead to the development of expertise. In many fields where expertise has been systematically studied, including chess, music and sports, development beyond intermediate level requires large amounts of deliberate practice (Ericsson, et al., 1993) and good coaching (Ericsson, 1996; Charness, Krampe & Mayr, 1996).

How does deliberate practice differ from exercise based on full-scale realistic performance? Here are some key characteristics that distinguish deliberate practice:

1. Repetition. Task performance occurs repetitively rather than at its naturally occurring frequency. A goal of deliberate practice is to develop habits that operate expertly and automatically. If appropriate situations occur relatively infrequently or are widely spaced apart while performing "as you fight" they will not readily become habitual.

2. Focused feedback. Task performance is evaluated by the coach or learner during performance. There is a focus on elements of form, critical parts of how one does the task. During a performance these elements appear in a more holistic fashion.

3. Immediacy of performance. After corrective feedback on task performance there is an immediate repetition so that the task can be performed more in accordance with expert norms. When there is feedback during a "train as you fight" performance, it is often presented during an after-action review (AAR) and there is usually not an opportunity to perform in accordance with the feedback for some time.

4. Stop and start. Because of the repetition and feedback, deliberate practice is typically seen as a series of short performances rather than a continuous flow.

5. Emphasis on difficult aspects. Deliberate practice will focus on more difficult aspects. For example, when flying an airplane normally only a small percentage of one's flight time is consumed by takeoffs and landings. In deliberate practice simulators, a large portion of the time will be involved in landings and takeoffs and relatively little in steady level flight. Similarly, rarely occurring emergencies can be exercised very frequently in deliberate practice.

6. Focus on areas of weakness. Deliberate practice can be tailored to the individual and focused on areas of weakness. During "train as you fight" performances the individual will avoid situations in which he knows he is weak, and rightly so as there is a desire to do one's best.

7. Conscious focus. Expert behavior is characterized by many behaviors being performed simultaneously with little conscious effort. Such automatic elements have been built from past performances and constitute skilled behavior. In fact, normally, when the expert consciously attends to the elements, performance is degraded. In deliberate practice the learner may consciously attend to isolated elements because improving performance at the task is more important than performing one's best. After a number of repetitions attending to the element to assure that it is performed as desired, the learner resumes performing without consciously attending to the element.

8. Work vs. play. Characteristically, deliberate practice feels more like work, is more effortful than casual performance, and is often less engaging and fun than fully realistic performances. The motivation to engage in deliberate practice generally comes from a sense that one is improving in skill.

9. Active coaching. Typically a coach must be very active during deliberate practice, monitoring performance, assessing adequacy, and controlling the structure of training. Typically in "train as you fight" performances there are no coaches. Instead there are observer/controllers who attempt to interfere as little as possible in the performance.

'Think Like a Commander' Themes

Repetitive performance causes behavior to become automatic. It is important that the behaviors that become ingrained conform to those of an expert—that they are the right behaviors. It is a well-known phenomenon that novices, through play alone, will improve rapidly for a short time but then may continue performing for decades without further improvement. Practice alone does not make perfect; it must be structured to ensure that performance, in this case thinking, is done in a correct manner. In order to accomplish training using a deliberate practice method the student must perform selected task elements and strive to conform his or her performance to some model of 'correct form' or 'expert form.' If those desired elements of form have not been clearly identified, then the training will resemble the discovery learning of "train as you fight" more than it does deliberate practice. A critical component in the construction of the Think Like a Commander training for tactical adaptive thinking - an explicit set of expert tactical thinking behaviors - was formulated based on ARI interviews and research with acknowledged tactical experts (Deckert, Entin, Entin, MacMillan, & Serfaty, 1994; Lussier, 1998; Ross & Lussier, 2000). These eight behaviors are termed 'themes' of the training. Below is a list of the themes and a brief description of each:

Keep a Focus on the Mission and Higher's Intent -- Commanders must never lose sight of the purpose and results they are directed to achieve -- even when unusual and critical events may draw them in a different direction.

Model a Thinking Enemy -- Commanders must not forget that the adversaries are reasoning human beings intent on defeating them. It's tempting to simplify the battlefield by treating the enemy as static or simply reactive.

Consider Effects of Terrain -- Commanders must not lose sight of the operational effects of the terrain on which they must fight. Every combination of terrain and weather has a significant effect on what can and should be done to accomplish the mission.

Use All Assets Available -- Commanders must not lose sight of the synergistic effects of fighting their command as a combined arms team. They consider not only assets under their command, but also those which higher headquarters might bring to bear to assist them.

Consider Timing -- Commanders must not lose sight of the time they have available to get things done. Experts have a good sense of how much time it takes to accomplish various battlefield tasks. The proper use of that sense is a vital combat multiplier.

See the Big Picture -- Commanders must remain aware of what is happening around them, how it might affect their operations, and how they can affect others' operations. A narrow focus on your own fight can get you or your higher headquarters blind-sided.

Visualize the Battlefield -- Commanders must be able to visualize a fluid and dynamic battlefield with some accuracy and use the visualization to their advantage. A commander who develops this difficult skill can reason proactively like no other. "Seeing the battlefield" allows the commander to anticipate and adapt quickly to changing situations.

Consider Contingencies and Remain Flexible -- Commanders must never lose sight of the old maxim that "no plan survives the first shot." Flexible plans and well thought out contingencies result in rapid, effective responses under fire.

We believe the above set of eight tactical thinking behaviors is a good set for the following reasons. First, the behaviors are characteristic of high-level expert tactical decision-makers. Observing acknowledged experts, these elements can clearly be seen guiding their actions. Second, the concepts are familiar to most officers. They have been taught to do these things and generally are able to do them with some degree of proficiency. Third, observations of officers in realistic tactical performances indicate that they typically do not perform according to these norms; the more intense the exercise, the less likely are the officers to exhibit these behaviors. Fourth, the set describes thinking actions that can be loosely characterized as "what to think about" rather than "what to think." Fifth, and very importantly, the themes represent thinking behaviors that are relatively consistent over a wide range of tactical situations. Because of that consistency, the formation of automatic thought habits will occur more quickly at this level of generality than it will for the unique and specific aspects of each situation, that is, the inconsistencies of tactical thinking.

It is not sufficient to simply memorize the eight tactical thinking themes and learn the questions that commanders must ask. In fact, as has been indicated, the eight themes are already well known in one form or another to officers at the tactical level. The themes are not intended to be a checklist either. Difficulty with adaptive thinking is a performance problem, not a knowledge problem, and it will not be solved by the acquisition of additional declarative knowledge.

'Think Like a Commander' Vignettes

This section briefly describes the design of the Think Like a Commander training product; a more extensive description is available in *Think like a commander prototype: Instructor's guide to adaptive thinking* by Lussier, Shadrick, & Prevou, (2003). Shadrick & Lussier (2002) contains the training materials

used with U.S. Army captains. The central component of Think Like a Commander is a set of vignettes based on tactical situations drawn from a single overarching scenario. Each vignette begins with a short— typically two to four minutes in duration— audio-video file that presents the tactical situation.

While each vignette has no officially sanctioned solution, each does have a set of unique "indicators" that represent important considerations of expert battlefield commanders. These are the elements of the situation—the key features—that should play a role in the decision maker's thinking. For each vignette, 10 to 16 such indicators were determined. While the themes are consistent across all vignettes, each vignette has unique indicators that represent what an expert commander should consider in that specific vignette situation if he or she were to engage in the thinking behavior represented by the theme.
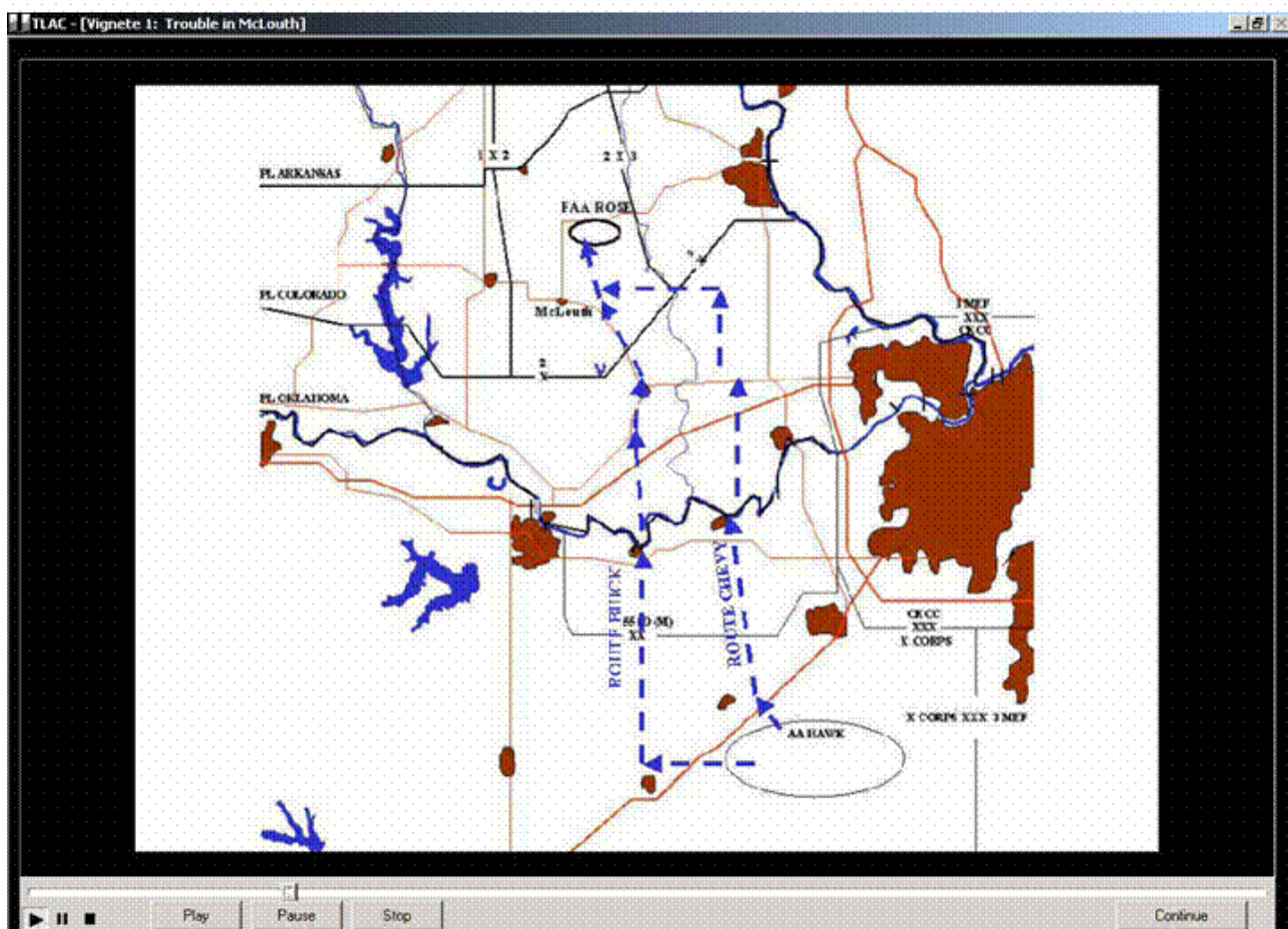

Figure 1. Think Like A Commander – Vignette Screen.

Once the presentation is completed, the student is asked to think about the situation presented and to list items that should be considered before making a decision. Over time, the instructor decreases the amount of time students are allowed, forcing them to adapt to increased time pressure. After each student completes his or her list, the instructor leads a class discussion. Class members discuss the second- and third-order effects related to actions students suggest. Students are encouraged or required to discuss and/or defend considerations relevant to the vignette. Such coaching by a subject-matter expert is a key part of the learning process to enable the student to develop expert habits.

In the final phase of each vignette, the students see the list of considerations that experts believed were important, along with the list they initially made, and they mark the indicators they have in common with the experts. Students are also asked to make the same evaluation on the class as a whole. The purpose in this step is to allow the student to get a true representation of their individual performance. For example, a student may only get fifty percent of the important considerations for a given vignette. During the class discussion, however, ninety to one hundred percent of the key considerations may be discussed. Students may inappropriately believe that their performance was directly linked to the performance of the class as a whole. Once the students rate their performances, they are given feedback linked to the general themes, (e.g., 25% for the 'Model a Thinking Enemy' theme). This individual feedback supplements and complements the feedback given by the instructor during the class discussion phase of the training. The students are then able to focus their future thinking on subsequent vignettes and place additional attention on themes for which they scored low.

Implementation and Evaluation

U.S. Army Captains in the Armor Captains Career Course at Fort Knox, KY received the adaptive thinking training using seven of the Think Like a Commander vignettes. Participants included 24 Officers enrolled in the course between January and May 2002. The training was facilitated by their classroom instructors. Each instructor received a 6-hour block of instruction on using the Think Like a Commander training. A senior instructor at the Command and General Staff College and the training program developer provided the instruction. The instruction included and involved discussion on adaptive thinking, information on how to use the materials, and techniques for facilitating an adaptive thinking discussion.

Implementation procedures were similar to those discussed earlier. After reviewing the vignette, students were asked to list all the important considerations that should be noticed from the vignette and were given a time limit in which to make their lists. Next, the instructor led a discussion of the vignette to further highlight the relevant teaching points from the vignette. Finally, students were required to complete the self-assessment section of the program. The procedures were similar for all seven vignettes. All student input was automatically saved for analysis.

Results

A number of performance measures were used to evaluate the success of the training. These measures addressed the critical thinking process (e.g., the number of critical indicators identified) and the ability to make rapid decisions (e.g., the amount of time spend determining indicators).

One key measure is the percent of critical information the student was able to identify within the time limit. The set of critical information is those items that were termed indicators in the previous section. They are a list of 10-16 items that expert tactical decision makers consider to be important considerations in the situation. A trend analysis was computed to determine trend effects through repeated use of the training application. A within-subjects trend analysis yielded a significant linear trend, $F(1, 23) = 34.21$, $p < .05$, indicating that participants identified significantly more critical information as they continued training.
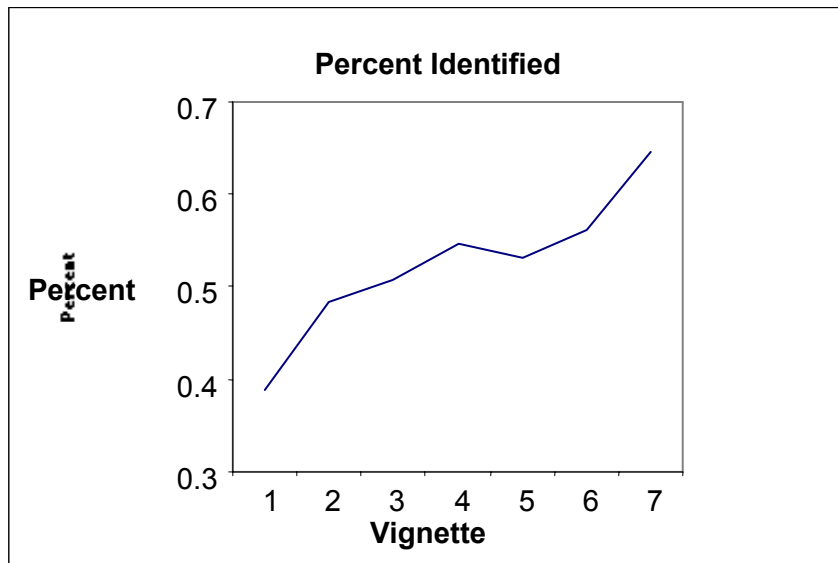
Figure 2. Percentage of Indicators Identified for Each Vignette

Students could not spend as much time as they wanted to complete each vignette. Time limits were imposed by the instructors. For the first vignette a time limit of 15 minutes was allowed for the student response portion of the exercise. The time limit was progressively reduced so that for the seventh vignette only 3 minutes was allowed. Figure 3 illustrates the amount of information considered per minute for each vignette.

For example, for vignette one, participants were allowed 15 minutes to complete the exercise and they identified an average of 6 considerations for the whole exercise, or a total of .41 considerations per minute. For vignette seven, participants were allotted 3 minutes to complete the exercise and participants
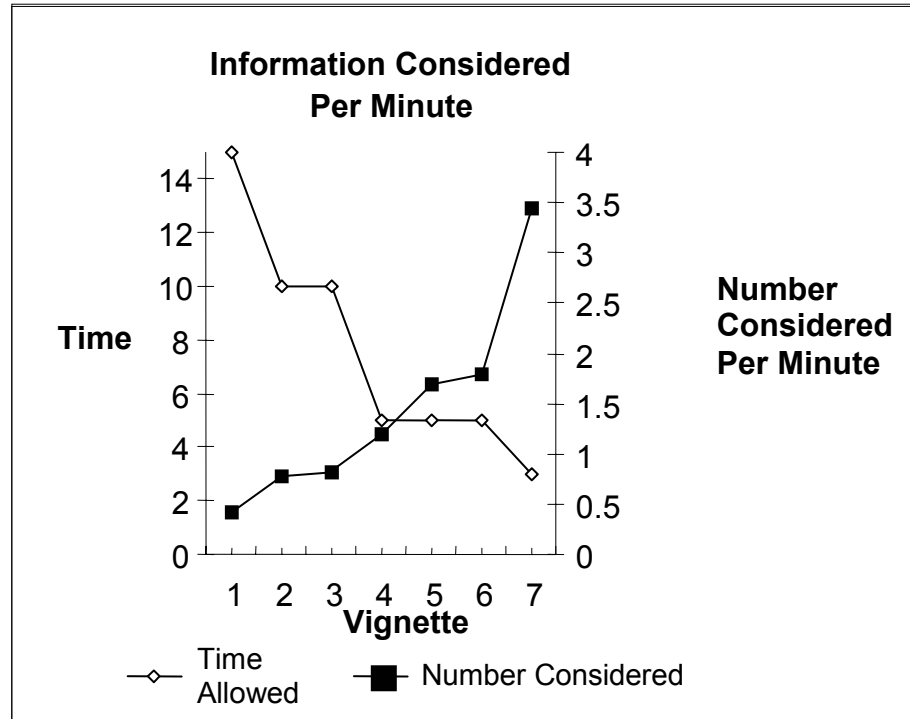
**Information Considered
Per Minute**

Figure 3. Percent of Information Considered per Minute.

considered just over 10 pieces of information. This corresponds to 3.4 considerations per minute. Finally, it is important to note that fatigue was not a problem for the training since students were given ample time between vignettes. Furthermore, students were motivated by their interest in the training and were actively involved in the training.

From a qualitative standpoint, both participants and instructors indicted that they enjoyed completing the Think Like a Commander training. Not surprisingly, the vignettes were able to generate lively discussion and kept the interest of the participants. Comments indicated that the students perceived the training as being valuable and many requested the software to take with them after completing the course.

Interpretation of the value of results such as these is always subjective. We feel in this case the increase is impressive particularly because each vignette presents a new tactical situation and the target considerations – the critical features that the students must identify – are also different each time. The results indicate a substantial rise in the students' ability to rapidly perceive and identify the critical features of tactical situations.

"How to Think" versus "What to Think"

Occasionally one hears a distinction made between training "how to think" and training "what to think." Indeed, previously in this paper we characterized the themes as "what to think about" as opposed to "what to think." It may be that such distinctions represent distinctions between procedural and declarative knowledge, or it may be that such distinctions, while sounding meaningful, are entirely vacuous. Recall that we do not believe we are primarily imparting knowledge with our training; rather we are shaping some fairly discrete and specific thinking behaviors.

When we were initially asked to develop adaptive thinking training it was clear that the requesters had in mind a much more portable thing, a thing in which the "how to think" and "what to think" distinction was meaningful. They envisioned a training program that turned the students into "adaptive thinkers" who, having once had the training, now thought differently, and who, as they went about various endeavors including tactical decision-making, would apply a new quality of thought to them and perform them more adaptively, whatever that might mean. While there are many adherents of generalized domain-free training in thinking skills, results of such training efforts are far from clear. In this research effort we thought it more promising to adopt a definition of adaptive thinking that was probably narrower than is often intended by the term, a definition that was very specific for the domain of tactical decision-making. We (Ross & Lussier, 1999) made the assumption that the ability to think adaptively is something that grows out of quality experiences within a domain and does not necessarily transfer readily to other domains.

Perhaps a meaningful way to approach the issue is in terms of the generality of the behavior being trained. For example, a very general thinking skill, which is applicable to a wide variety of situations, could be phrased "take a different perspective." A more specific instance, tailored to battlefield situations would be embodied in a rule such as "if the enemy does something you didn't expect, ask yourself what purpose he hopes to achieve by the act," a behavior that inclines one to take the enemy perspective. A yet more specific instance would be "when you see an enemy-emplaced obstacle, ask yourself why he put it in that exact location and what he intends to achieve by it." Recall that these thought acts – these cognitive behaviors – are not part of a large checklist that one continually seeks to proactively apply to the environment, rather they are thought habits that operate within complex structures (i.e., mental models) and must be triggered by some stimulus event. When the triggering event is very specific and identifiable such as an enemy-emplaced obstacle the training may proceed readily but has a limited applicability. Achieving the desired effect of improving adaptive thinking in tactical situations would require an enormous number of such habits be trained. At the other end of the spectrum, the mandate to "take a different perspective" is so vaguely triggered and the act of taking the different perspective so broadly flexible that a tremendous and thoroughgoing training effort must be required to achieve any lasting effect, especially when one considers the attention-demanding and focus-narrowing environment in which we seek to affect behavior. Thus, we believe the course taken in this effort to be the most efficacious one; to place the themes at just such a level of generality that they represent thinking behaviors that are as specific as possible while remaining relatively consistent over a wide range of tactical situations. Because of that consistency, the formation of automatic thought habits will occur more quickly, and because of the specificity they will more likely operate in battlefield conditions.

Refining the Themes

While the themes – which represent our model of expert tactical thinking – and our formulation of them as eight roughly equal-valued items have proven useful in practice, a recent effort which involved observation of one-on-one vignette-based tutoring sessions with an expert mentor (Ross, Battaglia, Phillips, Domeshek, & Lussier, in preparation) is continuing to refine our understanding of them. The analysis of themes in the sessions and the post-session interviews with the expert tacticians helped us to see a more sophisticated use of themes than we had first suspected. We now believe that visualization is the key skill in tactical thinking, and the other themes support it. We define visualization as the ability to integrate the use of the other themes in response to a particular situation through the activation of mental simulation. We have observed that the basic themes, the adaptation of the themes to understand new situations, and mental simulation, which integrates the themes into a holistic view of the battlefield, can all be tutored and that practice using the themes in context creates deeper understanding.

Ross et al. have also begun to further develop the evaluation of the theme-based behaviors by developing behaviorally anchored rating scales, as for example in Figure 4.

T1: Keep a focus on the Mission and Higher Intent. Commanders must never lose sight of the purpose and results they are directed to achieve – even when unusual and critical events may draw them in a different direction.				
Focus on Own Mission	**Discriminate Intent and Explicit Mission**	**Model Effect of Own mission on HQ Intent**	**Accurate Predictions**	**Support Intent**
1	**2**	**3**	**4**	**5**
Articulates and understanding of the mission without any consideration of higher intent Neglects to keep HQ informed of plans and situations Neglects to request additional assets when the plan requires Ignores of loses sight of higher intent when distracted by unusual events	Is able to differentiate mission from higher intent, yet does not apply these differences to understanding the current situation in front of him Understands both mission and intent, but does not consider whether mission will support that intent or whether it needs to be modified in any way to better support intent	Considers whether the mission will support the intent Considers whether mission needs to be modified in order to better support the intent Considers ways to modify mission to better support intent Thinks through what has to be accomplished in order for the higher intent to be achieved	Mentally simulates how his mission will contribute to achieving a larger mission Prioritizes what needs to happen in order for the higher mission to be accomplished (e.g., I need to do this, instead of that.)	Articulates how and/or why his plan or COA supports the commander's intent Allows intent and current situation to guide the COA rather than the explicit mission

Figure 4. Behaviorally Anchored Rating Scale for Keep a Focus on the Mission and Higher's Intent Theme.

Future Directions

Two important and related considerations are transfer of the skills trained by Think Like a Commander to more realistic whole-task situations and degree of automaticity of the thinking behaviors. Neither an assessment of transfer nor of automaticity has been accomplished. It is unlikely that seven short vignette-based exercises involved sufficient repetition to reach even a low degree of automaticity. It has been noted, however, that instructors who participated in the training evaluation continued to provide coaching based on the themes as students participated in other exercises, including more complete simulation-based exercises. Both automaticity and transfer are a result of continued production of the behaviors performed in the training vignettes in a variety of tactical exercise settings.

In additional research, we are investigating the pattern of development of tactical thinking related to the themes. If the development of tactical thinking skills follows a consistent and discernable pattern then individual performance levels can be diagnosed, and training can be more efficiently targeted to individual needs. One consistent finding from a number of efforts (Deckert, et al., 1994; Ross, et al., 2003; Carnahan, Lickteig, Sanders, & Durlach, in preparation) shows that in novices the amount of attention focused on own forces, i.e., the theme Use All Assets Available, is much higher than the amount of attention placed on the enemy, i.e., the theme Model a Thinking Enemy, but becomes more balanced or reverses with the development of greater expertise. The finding has been noted in other fields, e.g., chess, where it is a

frequent observation that novices focus on their own plans and moves and seem to ignore what the opponent is doing. One explanation is that in order to act one must consider 'own forces,' and such consideration virtually exhausts the capacity of the novices to build, maintain, and operate their mental models. Only with increasing expertise are models of sufficient complexity to encompass both 'own forces' and 'enemy forces' possible. Another explanation (Ross, et al.) is based on the tendency of novices in all domains of expertise to jump to solutions before gaining a sufficiently deep understanding of the situation.

Other research based on Think Like a Commander training development focuses on the method of delivering coaching. Good coaching is seen as an integral part of the training method. In the work reported here instructors performed the coaching, i.e., live coaches were employed. Other research efforts currently underway are investigating various alternative methods of delivering the coaching component, including intelligent tutors, non-interactive presentations, live but distant coaches, asynchronous interaction with a live coach, and collaborative student groups.

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